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SAMUEL JAMES MELTZER[1]

DR. SAMUEL JAMES MELTZER was born in Curland, northwestern Russia, March 22, 1851. He received his preliminary education in a Real Gymnasium in Königsberg and his later training in the University of Berlin where he graduated in medicine in 1882. After taking his medical degree he decided to make his career in America, as the country which in his opinion had the best form of government. He had not sufficient means to make the journey and was therefore obliged to secure a position as ship's surgeon on one of the transatlantic vessels. On arriving in New York it was necessary in the beginning to devote his time mainly to building up a practise sufficient to support his family, but almost from the beginning he made arrangements also to give part of his time to research. From that period until his death on November 7, 1920, in his seventieth year he was a tireless investigator. When in the course of time the opportunity came to him from the Rockefeller Institute to give his time entirely to research he did not hesitate in making his decision. At a considerable financial sacrifice he abandoned his medical practise to devote himself to the kind of work that he most loved and most valued. By his good work and his high character he attained a position of honor and distinction in American medicine and endeared himself to his fellow-workers in all parts of the country. His productivity was remarkable. The list of his published papers includes over two hundred and forty titles, distributed among some forty-eight scientific journals of this country, Germany and England. These papers contain contributions to the subjects

[1] Read before the Federation of American Societies for Experimental Biology, Chicago, December 28, 1920.

of physiology, pharmacology, pathology and clinical medicine together with a number of lectures and general addresses. That he was an investigator of recognized standing in these several branches of medicine and was regarded as a valued contributor to so many scientific journals of the first rank is a striking demonstration of the breadth of his interests and knowledge. He was a member of twenty or more national scientific or clinical societies and in all of them it may be said he was prepared to take his part as an expert in the reading and the discussion of technical papers.

He served as president of the American Physiological Society, the Society for Experimental Biology and Medicine, the American Gastro-enterological Society, the American Society for the Advancement of Clinical Research, the Association of American Physicians and the American Association for Thoracic Surgery. The membership in these societies is composed of trained specialists. It is their custom to choose as their presiding officer only those who have made contributions of distinction to the subject to which the society is devoted. It seems to me unique in the modern history of medicine for one man to have received such special recognition from technical workers in so many different fields.

While his activities covered this large range he was interested primarily in physiology. "I belong," he said in a recent paper "to those who believe . . . that the knowledge of physiology is of special importance to clinical medicine." His work in this field entitles him certainly to be ranked among the foremost American physiologists. In attempting to present some estimate of the results of his labors I must limit myself mainly to his physiological activity. Indeed in this subject alone his papers are so varied that it will be possible to bring under review only what seem to be his major contributions. His first appearance as an investigator is recorded in a brief note in the *Proceedings* of the Berlin Physiological Society, May 14, 1880. In this note it is stated that Professor Kronecker exhibited a dog in which Herr Cand. Med. Meltzer had cut the nerves going to the mylohyoid muscle and thus demonstrated the importance of this muscle in the initial stage of swallowing. At a later meeting of the society in the same year Kronecker presented the full results of an investigation carried out by Herr Cand. Med. Meltzer under his supervision on the "Process of Swallowing." This paper was published subsequently by Kronecker and Meltzer in the *Monatsbericht der Königl. Akademie der Wissenschaften zu Berlin,* 1881. In this important contribution the mechanism of swallowing was given an entirely new interpretation which has since been generally accepted and is known as the Kronecker-Meltzer theory of deglutition. Meltzer had attracted Kronecker's attention while a student in his course. Out of this acquaintanceship developed an invitation to engage in a research and eventually a warm friendship between the two men that lasted throughout life. Meltzer's career was thus determined while still a student of medicine. Kronecker's influence attracted him to physiology and set his feet in the paths of research. The investigation in which they collaborated was important and original—just what part each contributed it is not now possible to discover, but it is interesting to find that this initial venture into research furnished a motif which can be detected recurring again and again in Meltzer's subsequent work. A companion paper upon "Die Irradiationen des Schluckcentrums und ihre Bedeutung" was published by Meltzer alone in 1883. It is a very suggestive paper on account of the careful analysis it contains of the far-reaching and curious effects in the central nervous system of the act of swallowing and also because in it Meltzer announces certain views upon the importance of the inhibitory processes which subsequently formed the basis of his theory of inhibition, and remained with him throughout life as a sort of compass by which to set his course on his voyages of discovery. He calls attention in this work to the fact that reflex excitation of the inspiratory muscles is accompanied by reflex in-

hibition of the expiratory muscles and vice versa, and he goes on to make the suggestion that a similar relationship must prevail in the case of all antagonistic muscles such as the extensors and flexors of the limbs. Some ten years later Sherrington gave the necessary demonstration that this interrelation does hold with the muscular antagonists, that the contraction of the one is accompanied by the inhibition of the other and he designated this relationship under the term of "reciprocal innervation." Meltzer meanwhile had been accumulating instances of this combined action of excitation and inhibition, but he neglected at that period to apply a distinctive name to this kind of correlated activity. There can be no doubt that when it is possible to label an idea with an appropriate designation its currency in the scientific world is greatly facilitated. In his paper on "The Self-Regulation of Respiration" read before the American Physiological Society in 1889 and published in the *New York Medical Journal* and under a different title in the *Archiv. für Physiologie* he describes experiments intended to show that two kinds of afferent fibers exist in the vagus nerve, one exciting and the other inhibiting inspiratory movements. He used this fact to modify the Hering-Breuer theory of the self-regulation of the respirations by assuming that the expansion of the lungs stimulates both groups of fibers. The resultant effect, as in the case of the simultaneous stimulation of the motor and inhibitory fibers to the heart, is a dominance of the inhibitory effect, thus cutting short the inspiration and bringing on an expiration. But after the inhibition ceases the excitatory fibers, which, like the acceleratory fibers of the heart have a long after action, come into play and start a new inspiration. In his first general paper on inhibition this idea of a combined action of opposing processes is extended by the citation of numerous instances taken from physiological literature and is expanded into a general theory which makes inhibition a universal property of irritable tissues.

> "I entertain and defend the view that the phenomena of life are not simply the outcome of the single factor of excitation, but they are the result of a compromise between two antagonistic factors, the fundamental forces of life, excitation and inhibition."

That is to say, whenever a tissue is stimulated two different processes are aroused, one leading to functional activity and one to a suppression of activity. As to the nature of these processes very little is said. He was not satisfied with the Hering-Gaskell conception that excitation follows or is an accompaniment of catabolic changes while inhibition is due to processes of an anabolic or assimilative character. He goes only so far as to assume that both processes are concerned with the kinetic and potential energies of the system, that excitation facilitates the conversion of potential to kinetic energy while inhibition hinders or retards this conversion, like the turning off or on of a stopcock. Nor was he satisfied with Sherrington's term of reciprocal innervation to describe all of the phenomena he had in mind. While this phrase is a suitable designation for the relationship between physically antagonistic muscles such as the flexors and extensors it is less appropriate in other cases, for example the simultaneous phases of contraction and inhibition exhibited in peristalsis. In later papers he suggested first the term *crossed innervation* borrowed from von Basch, but subsequently adopted the designation of *contrary innervation* as more applicable to the whole series of phenomena which he was considering. This process he believed is universal in its action—it is "manifest in all the functions of the animal body." Moreover his experience and observation as a practising physician led him to believe that "a disturbance of this law is a factor of more or less importance in the pathogenesis of many disorders and diseases of the animal body." In this way he would explain in part at least the muscular incoordination in tabes and the gastric crises of that disease, as well as gastric and intestinal colic in general. If the orderly sequence of a peristaltic wave is

disturbed so that the advancing wave of contraction meets a contracted instead of an inhibited area conditions are present which may well bring about a distension sufficient to account for the pain of colic. He gives many other illustrations of pathological conditions which may find a plausible explanation on the assumption of a disorder or disharmony in the law of contrary innervation. How far Dr. Meltzer was correct in the applications of his theory it is not possible to say. In all probability some of the specific instances that he cites in support of his views are amenable now to other explanations. But it is a fact, I believe, that he was much in advance of his earlier contemporaries in the emphasis he placed upon the significance of inhibition in the general activities of the body. The story is far from being told but it may be said that physiological thought since 1883 has tended more and more toward some such general conception of the rôle of inhibition as was in Meltzer's mind. For him at least it was a rewarding theory, it played, as he expressed it, a dominating part in all of his researches. One can not wholly appreciate his work nor understand his position on controversial points unless this attitude is born in mind. His theory of shock for example to which he held tenaciously was that "the various injuries which are capable of bringing on shock do so by favoring the development of the inhibitory side of all the functions of the body." There is a shifting of the normal balance toward the side of inhibition.

The most important of his contributions in later years will be found in three series of researches, one dealing with the action of adrenalin upon the blood-vessels and the pupillary muscles; one with the inhibitory action of magnesium sulphate and the antagonistic effect of the calcium salts, and one with the development of his method or artificial respiration by pharyngeal and intratracheal insufflation. The first series consists of eight or nine papers, mostly in collaboration with his daughter. They showed in this work that the temporary action of adrenalin upon the blood-vessels may be converted into a long-lasting effect, in the case of the ear-vessels, if these vessels are first denervated by section of the vaso-motor fibers in the sympathetic and the third cervical nerve. A more striking result still was obtained for the iris. In the mammal subcutaneous injections of adrenalin in moderate doses have no effect upon the size of the pupil, but if the superior cervical ganglion is first excised then, after a certain interval, subcutaneous injections bring on a marked and long-lasting dilatation. His explanation of these phenomena was made in terms of his theory of inhibition. Whether or not his views in regard to the relations of the cervical ganglion to pupillary dilatation will stand the test of future experimental work it is to be noted that the observation itself constitutes a significant instance of a kind of independent physiological activity on the part of a peripheral ganglion. The bearing of these facts upon the prevalent conception of the rapid destruction of epinephrin in the tissues was brought out especially in a paper with Auer in which it was shown that if adrenalin is injected into a ligated limb and an hour or so afterward the ligature is removed the dilatation of the pupil quickly follows, thus demonstrating that for this long period the adrenalin had remained unaffected by the tissues. Incidental results of this series of experiments were his discovery of the use of the frog's eye as a biological reagent for the detection of small concentrations of epinephrin and the rapidity of absorption in intramuscular as compared with subcutaneous injections.

The work upon the inhibitory and anesthetic effects of magnesium salts gave rise to no less than twenty five papers, most of them published in collaboration with one or another of his associates but chiefly with Dr. Auer. The peculiar inhibitory action of magnesium sulphate had attracted his attention as far back as 1899, and he reported upon it incidentally in a communication to the American Physiological Society. But in 1904–05, influenced again by his general conception of the importance of the inhibitory

processes he took up with Auer a careful physiological study of its action. The results were most interesting and important. When given subcutaneously in certain doses the magnesium sulphate produces a condition of complete unconsciousness and muscular paralysis or relaxation, which is reversible, in the sense that when the animal is given proper care it recovers. Later he was able to show that out of this condition of profound depression or inhibition the animal may be restored to complete consciousness and motility with miraculous suddenness by the intravascular injection of small amounts of calcium chloride. No one who was fortunate enough to see this demonstration as given by Dr. Meltzer will forget its dramatic effect upon his audience. A healthy vigorous rabbit was brought quickly to a condition of complete immobility and apparent death by the magnesium sulphate and then even more suddenly raised from the dead and restored to its normal tranquil existence by the injection of some calcium chloride. Meltzer and his collaborators investigated various phases of this action of magnesium sulphate and all of the results obtained tended to strengthen in his mind the conviction that in magnesium he had discovered the element in the body that is especially concerned in the processes of inhibition. The antagonistic action of the calcium although exhibited in such a striking way was not in his opinion specific. His own experiments in connection with the results reported by other observers led him to the general view that calcium serves to balance the abnormal activity of the other kations, potassium, sodium and magnesium, whether this abnormal action is in the direction of excitation or of inhibition. Modern work upon the physiological significance of the inorganic constituents of the body fluids which was begun in Ludwig's laboratory, but was given its main inpetus by the striking contributions of Ringer had concerned itself chiefly with the salts of potassium, sodium and calcium, which alone seemed to be sufficient to maintain normal conditions of irritability. Meltzer's work has shown that magnesium also has its place in this ancient balance of powers through which the functional activity of protoplasm is controlled. One can understand that in arriving at these results he must have felt that he was approximating at least a demonstration of the correctness of his general conception of the rôle of inhibition in functional activity. In this as in all of his experimental work Meltzer was eager to give his results a practical application to the art of medicine. The possibilities of the use of magnesium salts as an anesthetic agent in surgical operations were tested with some success on human beings and more important still its efficacy in controlling the spasms of tetanus has had a wide and promising application.

His last extensive series of researches dealt with anesthetization and artificial respiration through pharyngeal and intratracheal insufflation. Something like twenty-eight papers, most of them in collaboration with pupils or assistants, were devoted to this subject. His interest in this topic seems to have been stimulated by the fact that in his use of magnesium sulphate for anesthetic purposes the chief danger lay in the inhibition of the activity of the respiratory center. To meet this difficulty he undertook a study of the methods of artificial respiration. The initial paper in 1909 by Meltzer and Auer described a method of artificial respiration by continuous insufflation of the lungs through a tracheal catheter. It was found that by this means not only could an animal be kept alive without the action of the respiratory movements to fill and empty the lungs, but that it furnished also a convenient and efficient method for anesthetization. The use of this method in animal experimentation and especially its use in human surgery of the thorax and facial region was apparent and on many occasions Meltzer sought to make known its advantages and to ask for an adequate trial of its merits at the hands of the practical surgeons. The method has found some acceptance and the application of the principle involved will no doubt be extended in the future as the technique of thoracic surgery improves. It was

in recognition of the importance of this work that the American Association for Thoracic Surgery asked him, a physician and laboratory worker, to serve as their first president. It was natural that this work should have led him to consider the whole matter of artificial respiration in its relations to resuscitation after accidents of various sorts. His general paper in the *Medical Record* for 1917 giving a history and critical anlysis of the methods of resuscitation is an interesting and valuable contribution. He gives experimental data to prove that his device of intratracheal insufflation is the most efficient method of artificial respiration both for man and animals. But he realized that it is a method which requires special knowledge and training for its successful execution, and his broadening acquaintance with and interest in the practical aspects of resuscitation led him to experiment with the less efficient and less safe method of pharyngeal insufflation. He was a member of the three national commissions on resuscitation and served as chairman of the third commission. In connection with the duties of this service he devised a simple portable form of apparatus for pharyngeal insufflation which can be used with very little previous instruction and he demonstrated, with entire success I believe, that this form of apparatus is much more efficient than any of the so-called manual methods of resuscitation, or than any of the special machines for this purpose, pulmotors and lungmotors, which have been exploited commercially during the past few years. It was, I imagine, a sore disappointment to him that he was not able to convince his colleagues on the third commission that this apparatus met all the requirements for industrial and military use. It is probably the simplest and best instrument yet devised for artificial respiration as applied to man, and in institutions or industrial establishments where the need for artificial respiration may arise frequently and where special individuals may be instructed in its use it can be employed to great advantage. But it does require some little amount of training to use it properly—the average uninstructed man or woman can not be trusted to apply it intelligently, and for this reason the commission felt that it was wise to urge adoption of a manual method as the form of first aid which may be applied most successfully under ordinary conditions.

While the researches that I have attempted to summarize represent his most important contribution to physiological science, Dr. Meltzer kept in close touch with the progress in almost all branches of experimental medicine. He gave evidence of this interest in the publication of occasional papers on various topics or in articles of a general character. Shock, cardiac arrhythmias, therapeutics of self-repair, hemolysis, thyroid therapy, edema are among the subjects upon which he wrote, but probably the most original and helpful of his general papers is his well-known Harvey Lecture, 1906, on "The Factors of Safety in Animal Structure and Animal Economy." He applied this engineering term in a convincing way to describe the reserve powers possessed by many of the mechanism of the body. Doubtless the general conception involved had occurred to many others, but no one before him, so far as I know, had developed the idea so comprehensively and made of this provision a leading factor in the adaptation of the economy to its environment. The happy phrase that he employed served to precipitate the loose thought upon the subject, and its frequent recurrence since in medical literature is proof that the conception which it expresses has found wide acceptance in scientific circles. It is evident that his own thoughts were turned in this direction by the work of Chittenden upon the minimum protein diet. While he accepted, of course, the facts demonstrated by this observer in regard to the possibility of maintenance upon a low protein diet he was not willing to believe that a minimum diet is also an optimum diet in relation to the various metabolic stresses to which the body may be subjected. The experiences of the great war may serve to show that he was correct in taking this position.

To do full justice to the influence exerted upon contemporary medical research by Meltzer's work would require a careful analysis of the entire medical literature of the period, for, as I have tried to indicate, his sympathies were very broad and his activity was great. In some measure, either as interpreter or contributor, this influence was felt at many of the points of contact between medical science and medical practise. The border land between these subjects was in fact his special field of work. He had the spirit and ideals of the scientist, and knew at first hand what research work really means. He had experienced the labor and care and devotion required of those who aspire to increase knowledge. On the other hand he had a personal realization of the difficulties and necessities of medical practise and so was especially fitted to act as a sort of liaison officer between the two great wings of the medical army, the investigators who have the difficult task of discovering new truths, and the practitioners who must learn to apply these truths to the preservation of health and the protection from disease. No one in our generation, I venture to say, was more useful in this country in bringing about a helpful and sympathetic understanding between the laboratory worker and the physician. As a physiologist he enjoyed the best opportunities and training of his period. He was equipped with the methods and technique that the subject owes to the great masters of the latter half of the nineteenth century. The more modern methods of physics and chemistry which seem to be essential for the new generation of physiological workers he did not possess, but he did not let this deficiency discourage him nor diminish in any way his activity in research. He had the wisdom to understand that the armamentarium with which he was provided was adequate for the accomplishment of much important and necessary investigation. He was no faint-hearted seeker after truth. There never was a time, I fancy, in his active life when his mind was not full of problems that he wished to solve and which he intended to solve in part at least with the aid of his experimental methods.

Dr. Meltzer was elected to membership in the American Physiological Society at its first annual meeting held in Philadelphia in December, 1888. From that time until his death he was perhaps its most faithful member in attendance, in the presentation of papers and in participation in the discussions and social intercourse. Other less heroic spirits might weary under the load of papers and seek respite and fresh air by frequent disappearances between acts, but this was never the case with Meltzer. He loved the meetings, he loved to listen to the papers and to take part in the discussions. He had something to say of value on almost every paper that was read. It is small wonder therefore that his position and influence in the society constantly increased in importance. He served as president from 1911 to 1913, but the older members know that before that time and since his advice was paramount in matters of policy as well as in the selection of officers. He was sincerely and deeply interested in the welfare of the society and believed in its importance as one of the major agencies concerned in the advancement of the cause of physiological research. What he had to say in regard to its policies was always said in the opening meetings and in the plainest of terms, and if in his opinion it was necessary to be critical of either persons or things he never hesitated to express what was in his mind. His courage in stating his position in matters in which some personal criticism necessarily played a part in the discussion has often aroused my admiration. He did not indulge in circumlocutions or euphemisms, but was entirely frank and direct. There could be no mistake as to what he thought and yet no matter how plainly and bluntly he might speak there was as a rule no offense taken, because it was evident to every one that what concerned him was not personalities but the principles involved. The American Physiological Society owes much to him for the sound policies and wholesome traditions which have characterized its his-

tory. I have not so much direct knowledge of the influence exerted by Dr. Meltzer in the numerous other societies of which he was a member. In the case of the Society for Experimental Biology and Medicine we know that he was its chief founder and for many years its primum movens—it was long known familiarly among scientific men as the Meltzer Verein. I have no doubt that in every organization with which he was connected his influence was always exerted on the side of the highest scientific ideals—no other position was possible for him. He was high-minded, courageous, sincere and optimistic. Age oftentimes lays a stiffening hand upon the scientific worker, causing him to shrink from the laborious routine of research, but with Meltzer there was never any indication of weariness or sense of failure. In spite of much ill-health and physical suffering in his later years he was full of hope and energy and determination in the pursuit of his scientific ideals and problems. Death came to him, as he would have chosen, while in his study and at his work. He was a good and faithful servant in the cause of medical research. Rewards came to him in the form of academic honors and membership in the most important medical and scientific societies, but I am confident that he found his greatest recompense in the joy of the work and in the affectionate appreciation of his many scientific friends.

W. H. Howell

THE RELATIONS OF PSYCHOLOGY TO MEDICINE[1]

A sufficient excuse for this discussion of an old theme is the notable rapid progress of both psychology and medicine, and the consequent changes in their actual and prospective relations. Fresh consideration of the question what should be the relation of psychology to medicine may benefit alike the sciences and the art concerned. The discussion may not be exhaustive; instead, it must be limited to an outline of the theme and the indication of those characteristics of the two principal subjects which are preeminently important as conditions of profitable working relations.

Medicine as an art strives to maintain or restore the health of the human being. The object of the physician's concern, his patient, ordinarily is both active and conscious. It is therefore desirable that the practitioner be thoroughly grounded in the facts and principles of human action and experience. Although this may seem self-evident, it has not been accepted generally in medical education. The history of medicine indicates that it has long sought to attain a reliable and adequate scientific basis for the practise. Naturally enough, knowledge of structure was first of all sought, and in consequence, the science of gross anatomy developed. Subsequently it gave rise to histology, cytology, embryology, pathological anatomy, and bacteriology, all of which are now recognized as essential morphological bases for the art of medicine. Paralleling the growth of the knowledge of structure, although somewhat more recently and more slowly developed, are the various sciences which deal with organic functions. Among these, human physiology was first chronologically, and first in importance to medicine. For several centuries it has grown steadily, gradually extending its inquiries to most of the important types of organic process. From it have arisen a number of special sciences of function and its alteration, as, for example, in immunology, pathology, and certain aspects of pharmacology. But strangely enough, physiology has failed to take possession of those large and important groups of phenomena in human life which are designated by the terms behavior, conduct, experience, and mind.

[1] Address of retiring vice-president and chairman of Section I, American Association for the Advancement of Science, Chicago, 1920.

Viewed as functional aspects of human life, these phenomena appear to be wholly appropriate material for the science of physiology. That they have not been considered other than casually is doubtless due to the difficulty of devising methods for their exact study, and the historical relation of conduct and experience to philosophy and to the experimental psychology which emerged from it.

It seems entirely fitting to ask, in view of this limitation of the scope of physiology and the dependence of medicine upon thoroughgoing and intimate knowledge of life processes, does medicine need a science of human behavior and experience as one of its fundamental or basic disciplines? A generation ago this question would have been answered in the negative by the majority of physicians, possibly even by many of those who were most intimately responsible for the development of physiology. At present, the situation is radically different, because it has become clear that the science of psychology has developed important methods and assembled a body of facts whose theoretical and practical importance can not safely be ignored. Demonstrations of the practical applications of mental measurement, as for example in the army, in educational institutions, in industry, in penal institutions, and in hospitals, have attracted the attention of intelligent physicians, and have caused many of them to take an aggressive and constructive attitude with respect to the relation of psychology to medicine. They will unhesitatingly give an affirmative reply to the important question which has been formulated, and will earnestly support their position by pointing out the vital importance of knowledge of human action and human experience in every practical situation which confronts the practitioner. Some of them may go so far as to maintain that the average physician of to-day is quite as ignorant of the structure and functions of the human mind and of the activities through which experience gains expression, as were his predecessors of a thousand years ago of the structure and functions of the body. And they may further maintain that most physicians are entirely untrained in methods of observing and measuring human action and experience, and therefore unable to apply even the simple and well established procedures of practical mental measurement.

Assuming, then, that the medical profession recognizes its need of systematic knowledge of human behavior and experience and of the technique necessary to the acquirement and extension of such knowledge and its practical use, it is necessary to consider next whether psychology or any other existing discipline is prepared to meet this need, and if so, how it may best be done. This necessitates an examination of the status and meaning of psychology.

It is unfortunately true that many intelligent and highly educated persons, among whom are some physicians, are confused and misled by the diverse developments of psychology. This is chiefly because psychical research, spiritualism, certain kinds or fragments of philosophy, mental telepathy, isolated products of introspection, and various methods of studying behavior and conduct, each and all claim the name psychology. It is inevitable that this state of affairs should confuse the person who, unacquainted with the problems of behavior and experience and likewise unfamiliar with the methods of solving them, views the manifestations of psychology as an interested observer. It should be remarked, however, that the situation is not essentially different from that in medicine, for there the disinterested observer notes the existence of

numerous medical sects, each of which more or less insistently and ostentatiously claims for itself either a monopoly of what is useful in medical practise or the most fruitful of therapeutic methods. The layman, consequently, has grave doubts and misgivings about the trustworthiness of the art of medicine and the adequacy of its scientific basis, which are identical in principle with those entertained by the physician for psychology. It is therefore very much to the point to establish the fact that there exists a genuinely reliable, thoroughly scientific, and progressive science of behavior and experience, which rightly claims the name psychology, just as there is a reliable body of knowledge concerning human form, function, and disease, which is called medicine. The fact that the word "regular" must be used by a certain group of medical men to distinguish themselves from other medical sects should not be overlooked in this connection, for what is desirable or necessary in medicine happens to be equally so in psychology. It is also true that the broadminded, genuinely scientific psychologist is likely to be as much offended by the name telepathist, or spiritualist, as is the "regular" physician by the name eclectic, or osteopathist.

There are at least five principal phases or aspects of modern psychology which deserve mention although they have widely differing significance for medicine. They may be designated as philosophical psychology, psychical research, introspective psychology, genetic psychology, and behaviorism.

Philosophy, not many generations ago, included all of the disciplines which are now called natural sciences. Psychology has been slowest to emancipate itself, chiefly because its phenomena are most difficult to study by scientific methods. From certain points of view, philosophical psychology is quite as important as any other aspect of the subject, but for the present, at least, it need not especially concern medical education or medical practise, and least of all should it be permitted to obscure the development of psychology along lines similar to those followed by the other natural sciences.

Despite claims to the contrary, psychical research, and the spiritualistic developments of psychology, are too uncertain of their facts and either too uncritical or unreliable as to methods to be seriously considered in connection with practical problems. What may develop from or through them it would be rash to attempt to predict, but it is obviously safe to maintain that they do not constitute the science of psychology and lack immediately important significance for medicine.

The primary development of psychology and its center of reference is the psychology of the self. This is necessarily a product of introspection or self-observation. It is the aim of introspective psychology to discover the elements of experience, to formulate the laws of their combination, and to describe those complex phenomena which constitute mind. That much has been achieved in this direction must be evident to any intelligent person who reads attentively the works of leading introspective psychologists. Medicine can no more afford to neglect this important method of studying experience and its expressions than can education or any other art which works upon human material. But it is equally true that introspective psychology may not fairly or profitably be accepted as the whole of the science.

The term genetic psychology has been applied to the historical or developmental description of behavior and experience, which results from the application of the

method of comparison to the materials of observation. In this branch of psychology, the development of behavior and of mind in the individual and also in the race is studied by means of objective methods similar to those of physiology, and by the method of self-observation whenever it is applicable. Genetic psychology is even more intimately related to the medical sciences and their practical applications than is introspective psychology.

The name behaviorism has been applied to a recent development which, in effect, is a revolt against the introspective method. By the application of objective methods identical with or similar to those of physiology, it undertakes to discover and describe the various phenomena of mental life and to formulate their laws. In its extreme form, it is merely the extension of physiology to include all types and aspects of human activity and experience. It may be pointed out in this connection that the science of physiology has made few attempts to study forms of activity other than reflexes. Behaviorism would alter this situation by subjecting instinctive, habitual, and voluntary actions to scientific analysis and measurement.

It has been asserted that the general science of psychology is neither psychical research, on the one hand, nor its logical extreme behaviorism, on the other hand. Instead, like medicine, it is inclusive of what is valuable in the methods and reliable in the results of all of its branches, aspects, or special developments. For psychology in its medical relations, the term psychobiology is proposed. This term suggests the study of experience as biological phenomenon. In introspective psychology, in genetic psychology, and in behaviorism, there is much that should be valuable to medicine. Assuming that it comprehended the important scientific procedures and the established facts and principles of the several branches of psychology, psychobiology would constitute a natural bridge between physiology and psychiatry. On the one hand, it would appear as a mere extension of physiology to include human behavior and experience, and on the other hand, it would exhibit kinship to psychiatry in the utilization of the subjective or introspective method. Whether or not it be considered a distinct science, psychobiology would serve to link the basic functional science of physiology with neurology and psychiatry.

The history of medicine clearly enough indicates gradual emancipation from superstition and the slow achievement of that immense body of knowledge which renders medical treatment increasingly certain and safe. Throughout this history, mental disorders have been less intelligently, less scientifically, and less satisfactorily treated than have most others. One obvious reason for this condition of affairs is the lack in medical schools of any provision for the training of students in psychobiology. Medicine, by its passive attitude toward the development of this science, has permitted, if it has not also encouraged, the development of numerous one-sided and extreme sects whose avowed purpose is the cure of human ills by psychological means. There exist to-day several species of psychotherapy or psychological medicine, and, in addition, such religious movements as the Emmanuel Church Movement, which perhaps would not have developed and certainly would not have flourished so remarkably had medicine provided in its schools and hospitals for the development of psychobiology as it has for the development of physiology.

Granted that medicine needs psychobiology, and that the status of the science, although unsatisfactory in many respects, is

such as to justify its introduction in medical schools, what might immediately be undertaken? This question certainly should not be answered in the same way for all schools. Consequently the following possible lines of activity should be considered in their relations to local situations and special needs. Even though excellent general courses in psychology be available in colleges or other medical preparatory institutions, it may reasonably be maintained that psychobiology should be given a place, at least tentatively and experimentally, in progressive medical schools, for only in the midst of medical research, education, and practise, can psychobiological methods, knowledge, and laws, be rapidly and effectively developed to meet the needs of the physician.

The following activities are suggested as immediately practicable and desirable in the larger medical schools, provided always that a thoroughly competent biologically trained psychologist is available.

I. There could be presented, initially as a voluntary course, if it is not expedient to add a new subject to the curriculum, a lecture, demonstration, and laboratory course in psychobiology, which should acquaint medical students with the principal facts and laws of human behavior and experience and with the more important methods of observing and measuring these phenomena.

II. A groundwork in psychobiology having been prepared by the general course, opportunity should be afforded interested students for more intensive training in the use of psychobiological methods. This should provide alike for training in the methods of practical measurement and for psychobiological research. In connection with the latter, investigation might be undertaken of problems formulated in the lecture course in connection with such topics as the analysis of instinctive activities; the development, modification, and integration of habits; the nature and significance of ideational types; the discovery of peculiarities or defects of behavior and experience. Similarly in connection with practical psychobiological measurement, the medical student might be given opportunity to utilize or develop methods of measuring aspects of behavior and experience in relation to diagnosis and treatment. Important types of practical psychological tests might also be exhibited in their relations to medical aspects of hygienic, industrial, and educational problems.

III. As an extension of psychobiology toward psychiatry, special lectures and laboratory exercises dealing with atypical, abnormal, or pathological behavior and experience could be provided. These might ultimately be expected to develop into a systematic course in psychopathology, which should be carefully correlated with the established medical instruction in neurology and psychiatry. In this same connection, as a method of supplementing such practical and research activities as are referred to in the preceding paragraph, psychobiological methods might be placed at the service of the neurological and psychiatric clinics, for psychology has already developed a considerable array of methods whose diagnostic value in neuropsychiatric practise has been definitely established.

IV. Another important field of service for psychobiology is preventive medicine and hygiene. Here, research in connection with the characteristics and variations of behavior and experience which are significant of undesirable or dangerous nervous or mental tendencies is particularly in point, although didactic lectures might also be offered to advantage. Thus psychobiology might be utilized increasingly as

the partial scientific basis of mental hygiene.

It is the conviction of the writer that urgent need exists for pioneering in psychobiology as a basic medical science. It has already been suggested that this pioneering should be done in a medical environment, for by taking the matter into its own hands the medical faculty should be able to secure, more quickly and satisfactorily than otherwise, those developments and applications of psychobiology which are clearly desirable. It will not suffice to meet the general needs of medicine, if psychopathology instead of, rather than in addition to, the more inclusive discipline psychobiology, is established in leading medical schools. For it is quite as improbable that the medical student will acquire adequate training in psychobiology during his premedical years as that he will acquire similarly adequate training in physiology or in anatomy.

There are three important possibilities with respect to the administrative relations of psychobiology in medical schools. The subject may be treated as a part of physiology, it may be established independently, or it may be associated with neurology and psychiatry. For the sake of its development as a fundamental discipline, it would appear preferable to have it either associated with physiology or given an independent status during the experimental stage of its development in a medical environment. To place it with physiology would tend to lessen administrative problems and to simplify the organization of instruction and arrangements for research, but, on the other hand, it should be recognized that the clinical relations of psychobiology are likely to be much more numerous and compelling than those of physiology and to make it more and more truly the connecting link between physiology and psychiatry. For the former subject, it must always appear as a logical extension of its field of interest; for the latter, as an essential part of its scientific basis.

ROBERT M. YERKES
NATIONAL RESEARCH COUNCIL,
WASHINGTON, D. C.

SCIENTIFIC EVENTS

MEDICAL EDUCATION IN CHINA[1]

RECENT reports state that in all China there are found to be less than 2,000 physicians. What a small proportion of the population of 400,000,000 Chinese people can receive scientific treatment in case of illness or injury! In an effort to ascertain the exact number of students looking toward medicine, if not also to stimulate the youth of China to look toward the practise of medicine, a survey has recently been made of the middle schools of China. In 153 of the institutions reporting, there are 36,095 students, and of these 1,153 stated that they were planning to study medicine. Since this is only about 20 per cent. of all middle schools, the total number who may enter on the study of medicine will be considerably larger.

The Rockefeller Foundation is said to have abandoned its purpose of erecting at Shanghai a great medical school similar to the Union Medical College at Peking. This decision is said to be due to the fact that in its initial session the college had a class of only seven students, although $6,000,000 had been expended for its construction and maintenance. This small attendance is said to be due to the fact that the medical course is given in the English language and that only a small number of the universities and schools in the neighborhood of Peking emphasize their courses in English. The situation is said to be quite different at Shanghai, where English is more generally taught, which will insure larger numbers of Chinese medical students.

In order to provide a clear field when a large

[1] From the *Journal* of the American Medical Association.

medical school in Shanghai was planned by the foundation, the Harvard Medical School of China was purchased by the Chinese Medical Board, and the Pennsylvania Medical School at Shanghai consented to step aside in favor of the larger institution. A few months ago, however, after the foundation withdrew from the field, the Pennsylvania Medical School began pushing forward its plans to enlarge its plant. The erection of a science laboratory building, to cost $100,000, was promptly begun. This will house departments of physics, chemistry and biology and, temporarily, the medical laboratories also, but the latter will be removed to other buildings which will be erected later. The institution will provide a premedical course covering three years, and a medical course of four years similar to those established by the Peking Union Medical College.

THE FOREST SERVICE

According to the annual report of Chief Forester W. B. Greeley, the receipts of the National Forests have increased 93 per cent. from 1915 to 1920, while the total appropriations for the Forest Service, exclusive of deficiency fire-fighting funds, has increased only 8 per cent. The receipts for 1920 were 10 per cent. greater than for 1919, and an equal increase for the current fiscal year may be expected, unless too much new business has to be rejected on account of lack of funds and trained employees. The appropriations for the current fiscal year were increased only 3 per cent.

In addition to the actual revenue, according to the report, there is an enormous return to the public through the protection of the 500,000,000,000-odd feet of timber for future use, the protection of the headwaters of innumerable feeders of navigation, irrigation and hydroelectric power and the recreational facilities made available to hundreds of thousands of people. "There will always be national resources not measurable in dollars which in public benefit exceed the receipts paid into the Treasury," the report says.

The purchases aggregated at the close of the fiscal year 1,420,208 acres in the White Mountains and the Southern Appalachians and 12,094 acres in the Ozark Mountains of Arkansas. The original program of acquisition contemplated the purchase of about 1,000,000 acres in the White Mountains and not less than 5,0000,000 acres in the Southern Appalachians. Nearly one half the proposed White Mountain area has been acquired, but slower progress has been made in the southern areas.

Further appropriations to carry on the purchase work within the areas have been recommended by the National Forest Reservation Commission. "To leave these Eastern forests in their present half finished condition would subject them to formidable fire hazards and other difficulties of management."

There is need also for some action to reduce the danger to the National Forests from the 24,267,723 acres of private lands that are intermingled with land belonging to the government. Most of this land is forested and its misuse, mismanagement and neglect jeopardize the government's holdings. General legislation is urged to acquire the private land by purchase or exchange.

The 1919 fire season was unusually severe and long drawn out, the report states. It was the third successive year of severe drought in the northwest, and the worst of the three. Fires began to occur before much of the customary work of preparation had been done, and this imposed a further handicap upon the forest force, which had been depleted by the loss of many experienced men. The total number of forest fires in the National Forests was 6,800, or 1,227 greater than in the previous year. The area of National Forest lands burned over was 2,000,034 acres, the estimated damage was $4,919,769, and the total cost of fire fighting was $3,039,615.

GYPSUM FELLOWSHIPS

At the recent annual meeting of the Gypsum Industries Association, they provided for six to eight fellowships, each bearing a stipend of $1,000 to $1,500 a year, depending on the training and ability of the holder.

These fellowships are to be located at various agricultural colleges in the eastern part of the United States for the purpose of investigating the use of gypsum in crop production and for making a fundamental study of the relation of sulphur to crop nutrition and growth.

The revival of interest in gypsum and other sulphur fertilizers has largely grown out of the remarkable results that agricultural scientists and farmers of Oregon and Washington are obtaining from the use of sulphur sources on alfalfa and clover, and other legumes. In many of the soils of these states a leguminous crop can not be successfully grown without an addition of a sulphur source, and such additions give increases in yield ranging from 25 to 500 per cent.

Two of these are to be used in continuing the fellowships that have already been in operation for considerably more than a year at the University of Chicago and at Iowa State College. The others will be strategically distributed at state agricultural colleges and experiment stations in central and eastern United States.

THE NATIONAL MUSEUM AND DR. JORDAN

ON the occasion of the seventieth birthday of David Starr Jordan, chancellor emeritus of Stanford University, which occurred on January 19, the following letter was addressed to him by Dr. Charles D. Walcott, secretary of the Smithsonian Institution:

On the occasion of your seventieth birthday, permit me, on behalf of the Smithsonian Institution and the National Museum, to offer my congratulations as well as thanks for your faithful cooperation during half a century.

For fully fifty years you have labored for the high ideals expressed by the founder of this institution in the words "increase and diffusion of knowledge among men," and for nearly the same period your work has been in close association with the institution and its staff.

Your work has also been intimately connected with the National Museum since its organization as such, and your scientific papers are among the most valued contributions to the museum's publications from its very first volume to the latest. Your early associations were with Baird, Gill, Brown, Goode and Tarleton Bean, and your name will go down in the museum's history linked with theirs. No wonder we have always regarded you as one of us, and we know that this sentiment is being reciprocated by you.

As a slight token of my appreciation of your services to science and to the museum, may I not ask you to accept the designation as honorary associate in zoology?

I trust that you may be spared for many more years to continue your work.

SCIENTIFIC NOTES AND NEWS

WILLIAM THOMPSON SEDGWICK, professor of biology in the Massachusetts Institute of Technology since 1883, died on January 25, aged sixty-five years.

AT a meeting of the Société belge de Médecine of Brussels, Belgium, held on December 27, 1920, Dr. William H. Welch, director of the school of hygiene and public health of the Johns Hopkins University, and Dr. Simon Flexner, the director of the Rockefeller Institute for Medical Research, were made honorary members of that organization.

THE dinner and reception given by the medical profession of Philadelphia to Dr. William W. Keen, at the Bellevue Stratford Hotel, on January 20, in honor of his eighty-fourth birthday, was attended by 600 physicians and friends. Dr. George de Schweinitz was the toastmaster, and the speakers included Dr. William H. Welch, Baltimore; Dr. J. Chalmers DaCosta, Philadelphia, and Mr. David Jayne Hill. Major-General Merritte W. Ireland, surgeon-general, U. S. Army, presented a specially bound volume containing addresses and letters as a tribute to Dr. Keen, and Dr. William J. Taylor, of the College of Physicians, presented a life size bust of Dr. Keen in army uniform, by Samuel Murray. Dr. Keen in responding made an address that will be printed in SCIENCE.

A PORTRAIT of Dr. Samuel W. Lambert, dean emeritus of the college of physicians and surgeons, Columbia University, was presented to the college on January 28. The presentation

was made by Dr. George S. Huntington, professor of anatomy.

The John Fritz gold medal for notable scientific and industrial achievement has been awarded to Sir Robert Hadfield, inventor of manganese steel and leader of the British steel industry. The award of the medal has been authorized unanimously by the sixteen members of the committee representing the national organizations of civil, mechanical, mining, metallurgical and electrical engineers. The medal was established in 1902 in honor of John Fritz, iron-master of Bethlehem, Pa.

The Honor Society of Agriculture, Gamma Sigma Delta, with chapters in the University of Minnesota, University of Nebraska, University of Missouri, Iowa State College, Oregon Agricultural College, Kansas State College, State College of Utah and Alabama Polytechnic Institute conferred honorary membership for distinguished services to agriculture on Dr. Eugene Davenport, of the University of Illinois; Dr. T. B. Osborn, of Yale University; Dr. H. P. Parmsby, of State College, Pennsylvania, and Dr. L. H. Bailey, of Ithaca, N. Y. The medal was conferred upon Dr Davenport.

The twenty-fifth anniversary of the publication of the discovery of the roentgen ray by Professor Roentgen has been celebrated with tributes to Roentgen in Germany. He retired last spring from the chair of experimental physics at the University of Munich.

Dr. E. O. Teale has been appointed government geologist of Tanganyika Colony, formerly German East Africa.

Professor E. B. Mathews, of the Johns Hopkins University, has been appointed chairman of the advisory council of the United States Board of Surveys and Maps.

The $5,000 prize offered by Mr. Higgins through the *Scientific American* for the best popular essay on the Einstein theories was awarded to the essay submitted by Mr. L. Bolton, of London. It appears in the *Scientific American* for February 5, and will be followed in subsequent issues by a number of the other essays, some in full and others in part.

Officers of the American Anthropological Association have been elected as follows: W. C. Farabee, of the University of Pennsylvania, president; A. V. Kidder, of Phillips Andover Academy, secretary; J. R. Swanton, of the Bureau of Ethnology, treasurer and editor.

The Missouri Society for Mental Hygiene was organized in St. Louis on January 13, with the following officers: Dr. M. A. Bliss, *president;* Dr. J. F. McFadden, *secretary;* Dr. J. E. W. Wallin, *treasurer.*

The American Journal of Psychology, established by Dr. G. Stanley Hall in 1887, and since edited by him, has been acquired by members of the department of psychology of Cornell University, and will hereafter be edited by Professor E. B. Titchener.

The Rockefeller Foundation announces the election of Miss Norma Foster Stoughton, to become assistant secretary of the Rockefeller Foundation, and Miss Margery K. Eggleston, to become assistant secretary of the China Medical Board, a department of the foundation. Miss Stoughton entered the staff of the Rockefeller Foundation in 1916 and has made a special study of hospital administration and service. Miss Eggleston has been since 1914 with the General Education Board, the China Medical Board and the Rockefeller Foundation. In addition to her position with the China Medical Board she has just been appointed assistant secretary of the trustees of the Peking Union Medical College, an institution erected and maintained in Peking by funds of the Rockefeller Foundation.

Dr. William W. Cort, associate professor of helminthology in the school of hygiene and public health of Johns Hopkins University, has been appointed director of the expedition recently formed by the International Health Board of the Rockefeller Foundation, New York, to study the hookworm larvæ in Trinidad, West Indies. The expedition will leave for Trinidad about May 1 and will be gone four months. Dr. Cort will be assisted by Dr.

J. E. Ackert, professor of parasitology of the Kansas State Agricultural College, and by Dr. D. L. Augustine, assistant in medical zoology at the Johns Hopkins University.

DR. LUDWIG SILBERSTEIN, of the research laboratory of the Eastman Kodak Company, delivered a series of fifteen lectures before the faculty and students of the University of Toronto on January 10–22. The first six lectures were devoted to explaining the general procedure of fixing events in space and time, and to developing the presence of special relativity with their consequences and applications to optics and to dynamics of a particle. The next six lectures were devoted to the conceptual as well as the mathematical aspects of general relativity and gravitation theory. The last three lectures were concerning the quantum theory of spectra.

AT the meeting of the American Philosophical Society on Friday evening, February 4, Dr. John C. Merriam, president of the Carnegie Institution of Washington, read a paper entitled "Researches on the antiquity of man in California."

THE Aldred lecture was delivered at the Royal Society of Arts on January 12, by Dr. C. S. Myers, director of the psychological laboratory, and lecturer in experimental psychology, University of Cambridge. The subject was "Industrial Fatigue."

THE American Roentgen Ray Society will award $1,000 to the American author of the best original research in the field of the roentgen ray, radium or radio-activity.

MARY WATSON WHITNEY, professor of astronomy emeritus and from 1889 to 1910 director of the observatory of Vassar College, died on January 20 aged seventy-three years.

DR. LINCOLN WARE RIDDLE, assistant professor of cryptogamic botany and associate curator of the Farlow Herbarium of Cryptogamic botany, died at his home in Cambridge on January 16 in the forty-first year of his age.

PRINCE PETER ALEXEIEVITCH KRAPOTKIN, distinguished as a geographer and for his books on science and natural history, has died at Moscow at the age of seventy-eight years.

M. PAINLEVÉ, professor of mathematics at Paris and former prime minister has returned from China to which he had been sent on a mission concerning Chinese universities and railways. He has obtained from the Chinese government the promise of an annual subvention of 100,000f. for an institute of Chinese higher studies in Paris. The Chinese government has also agreed to the creation, in one of the Chinese universities, of an affiliated branch of the University of Paris, and it will devote to this purpose the sum of 500,000f. annually, on condition that the French government gives the same amount. The Chinese president has further promised to have reproduced the collection of four great classics which contain the essence of Chinese civilization, and to present three copies to France. These volumes run to not less than 5,000,000 pages.

THE *British Medical Journal* states that the late Dr. A. J. Chalmers, the authority on tropical diseases, who died on his way home on leave in April last, left a valuable collection of medical books mainly on tropical diseases, and including some almost priceless incunabula. The whole of these, with the exception of about sixty volumes, presented to the Royal College of Physicians of London, have been given by Mrs. Chalmers to the Royal Society of Medicine, which has decided that the collection shall be kept together and be known as the "Chalmers Collection." Mrs. Chlamers has presented the society with the sum of £500 for the shelving and furnishing of a room in which the books will be kept as a memorial of her husband. It is hoped that the collection of books on tropical medicine will be added to from time to time, and the room chosen for the Chalmers Library is well adapted for the purpose. This coincides with the reconstruction of the new Section of Tropical Medicine and Parasitology. The section was formed in 1912, but was suspended during the war, and has only this session been formerly constituted. The new section will start with a library of its own—perhaps the finest collection of books on tropical medicine to be found anywhere.

The third half-yearly report on the progress of civil aviation in England has been issued as a White Paper. According to the abstract in *Nature* it is pointed out that regular air services have now been established from London to Paris, Brussels and Amsterdam, and that passenger, mail and goods traffic is increasing. The total number of aeroplane miles flown in the half-year ending September 30, 1920, is nearly 700,000, whilst the aggregate since May, 1919, exceeds 1,000,000. The number of passengers by air exceeds 30,000, whilst the goods carried weigh little less than 90 tons. In value the imported goods exceed £500,000, whilst the exports and re-exports are about half that amount. As part of the mail services, about 50,000 letters have passed each way between London-Paris, Brussels and Amsterdam with a regularity which is notable. Of the three routes the best shows 94 per cent. of deliveries within three hours of schedule time, and the worst 76 per cent. As part of the organization for further improving these records, it is stated that the wireless direction-finding apparatus installed at Croydon has proved its value, enabling aircraft to correct their course in thick weather. The equipment of aircraft with apparatus for wireless telephony is extending, as it is found to be of considerable assistance to navigation. The fatal accidents are given as in the ratio of 1 per 50,000 miles flown or per 5,000 passengers carried. The international character of flying is brought out in a statement of activities in other countries.

UNIVERSITY AND EDUCATIONAL NEWS

Following the investigations made by Professor S. C. Prescott, instructor in industrial biology of the department of biology and public health of the Institute of Technology, who has just returned from Seattle, where he studied the work of the College of Fisheries of the University of Washington, it has been announced that the administrative committee of the institute is considering the inclusion of a course in the scientific problems of fish culture and problems of the fisheries. Establishment of a college of fisheries similar to that of the University of Washington has also been suggested to Harvard University, by leading men in the fishing industry at Boston.

Heretofore Brazil has had no regularly coordinated university though she has had individual faculties vested with the power to confer degrees. The faculties of law and medicine and the polytechnic institute of Rio de Janeiro have now been combined and will be known henceforth as the University of Rio de Janeiro.

Dr. John M. Thomas, since 1908 president of Middlebury College, has accepted the presidency of the Pennsylvania State College.

Dr. E. K. Marshall, professor of pharmacology in Washington University, has been elected professor of physiology in the Johns Hopkins Medical School, beginning in July. Dr. Marshall received his bachelor's degree from Charleston College, 1908, and the doctorate in philosophy and medicine from the Johns Hopkins University.

At Yale University the following lecturers in special applications of organic chemistry in the industries have been appointed: Dr. Ralph H. McKee, professor of chemical engineering, Columbia University; Dr. Moses L. Crossley, research chemist, Calco Chemical Co.; Dr. P. A. Levene, biochemist, Rockefeller Institute for Medical Research; Dr. David Wesson, technical manager, The Southern Cotton Oil Co.; Dr. Harry N. Holmes, professor of chemistry, Oberlin College, and Dr. Elmer V. McCollum, professor of chemistry, School of Hygiene, Johns Hopkins University.

DISCUSSION AND CORRESPONDENCE

ASTRONOMICAL RESEARCH IN THE SOUTHEASTERN STATES

To the Editor of Science: In Science, December 10, 1920, page 545, I commented upon the interesting fact that the observatory of the University of Virginia, named after the donor, Mr. McCormick of Chicago, is the only active observatory in our southeastern states. My further comment that Barnard and other astronomical enthusiasts, born and grown to manhood in the former slave-holding states, had found their opportunities in the great

northern observatories, was incorrect and unjust, in that it overlooked the case of Dr. C. P. Olivier, for several years an astronomer in the McCormick Observatory. I regret exceedingly this oversight, and I am at a loss to explain it, especially as Dr. Olivier was for a year a member of the staff of the Lick Observatory, and his valued astronomical contributions are thoroughly familiar to me. It is my duty and pleasure to say that the observatory of the University of Virginia, thanks in good measure to the abilities and enthusiasms of Director Mitchell and astronomer Olivier, is as efficient in good works as any existing observatory. It is greatly to be regretted that their financial resources are so limited.

I should like to say that my comments upon the astronomical situation in the southeastern states were primarily not intended to be taken in the negative sense. There was with me the hope that a public expression on the subject might lead to a better realization of existing needs, and to more adequate financial provision in the positive sense.

W. W. CAMPBELL

TECHNICAL STUDY AT OBERLIN COLLEGE

IN SCIENCE for December 31 I find a note:

> It is planned to establish a technical school at Oberlin College with accommodation for about seven hundred students.

This statement is not quite correct. President King has several times proposed, upon his own responsibility and doubtless merely for informal consideration, a plan for technical departments chiefly in chemical engineering and metallurgy. I believe the proposal has not yet come to the faculty for formal consideration, so of course does not have their endorsement. As all matters of internal policy and administration in Oberlin are controlled by the faculty, in accordance with an old vote of the trustees twice recently reaffirmed and now in part of the nature of a contract, it is evident the proposal has not yet taken the first formal step toward adoption. President King, who is one of the staunchest supporters of this Oberlin system, apparently thinks that it is not yet time for formal consideration of the plan. It has been mooted for two years, and indeed over fifteen years ago something of the sort was suggested, but it has received only individual consideration by members of the faculty. Judging from numerous conversations, I think the faculty, if they are asked to consider it, will decide the plan to be unwise. A general feeling among the faculty is that Oberlin's effort should be centered upon strengthening herself in every way as a college before entering upon university or technical school work.

MAYNARD M. METCALF

URTHER REMARKS ON "THE USE OF THE TERM FOSSIL"

THE short article entitled "The Use of the Term Fossil" published in No. 1330 of SCIENCE seems to have fulfilled the writer's object of stimulating discussion. The first criticism, by Garret P. Serviss, appeared in the *Sunday American*[1] and while approving "poetic license" the author continues the plea for a more careful use of scientific terms by the scientist, as follows:

> Half the fogs that trouble the ordinary reader when he undertakes to traverse the fields of science are due to the capricious use of words which ought to have an invariable signification.

In No. 1348 of SCIENCE, under the title "Professor Field's Use of the Term Fossil," Professor Authur M. Miller suggests the following definition: "Any trace of an *organism* that lived in a past Geological Age." He then states that such expressions as "fossil suncracks" and "fossil flood plains" are "illuminating" and "apt" and "are valued contributions to geological phraseology." In a recent contribution by a well-known paleobotanist, we find the term "fossil climate." Would it be considered "illuminating" or "apt" to define paleoclimatology as the study of "fossil climates"? There is a science of words as well as of things, and is it not true that much of the

[1] July 22, 1920.

misunderstanding in biological discussions arises from the misuse of such terms as *mutation* and *saltation*? We would not quibble with Archbishop Trench's remark that words simply will not stay tied as regards their meaning but are "constantly drifting from their moorings," but the more the scientist allows his vocabulary to drift the more is he disturbed by the redefined or original terms of his colleagues who, believeing it impossible to use words of two, three or more meanings, continue to inflict long-suffering humanity with an ever-increasing nomenclature. Rather do we agree with Alice who, after listening to a dissertation by Humpty Dumpty in which he makes his words mean what he chooses them to mean—"neither more nor less," comes to the conclusion that his remarks are not particularly illuminating. Of course Humpty Dumpty was, among other things, a poet, not a geologist!

But Professor Miller also states that

> The definition proposed by . . . Field . . . is faulty in that it errs in the time concept. He has committed the popular error of considering historic synonymous with the present geological epoch.

This is an unfortunate misstatement by Professor Miller and it is only necessary to quote from the original text to show that Field was not making the "popular error" implied.

> A fossil is an object which indicates former existence of an organism which has been buried and preserved previous to historic time. According to this definition the mastodon preserved in the arctic ice is a fossil; the leaf buried in the gutter is not.

It is also worth noting that Schuchert and others distinguish the recent or *historic* period as beginning the Psychozoic era. If in agreeing with this concept an error has been committed, it is certainly not a "popular" one.

Paleontology, the study of ancient life, is literally the study of fossils. *Paleo* is accepted in earth science as meaning geologically ancient. As a last analysis, which is the more "apt," paleo climates or "fossil climates"?

Professor Miller's constructive criticism consists of the new definition already quoted. It has the advantage of being brief, but in using the expression "past geological age" (subdivision of the present geological epoch, *i.e.*, Bronze Age) he appears to make a very slight geological time distinction indeed. After careful reading of the whole text, we are under the impression that he means "past geological epoch" or *pre-historic!*

Richard M. Field
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Brown University

THE BIOGRAPHICAL DIRECTORY OF AMERICAN MEN OF SCIENCE

The third edition of the Biographical Directory is now in type; it will be published as soon as the printers can complete their part of the work. The editor ventures to ask for the return of all proofs and also for information in case proof has not been received. A second copy of the proof (by letter post and with return letter postage) has been sent to those who did not return the first copy within a reasonable time. If it is not known that a scientific man can be reached at the address given, or even that he is living, it will in most cases be undesirable to include the biographical sketch.

It is gratifying that the number of those engaged in scientific work in America has increased from about 4,000 in 1905 to about 10,000 at the present time. This circumstance, however, has greatly enhanced the labor and the cost involved in the preparation of the work, and it is not possible to write individual letters of enquiry in all cases where this might be desirable. The editor consequently makes public this request for the return of the corrected proofs of all biographical sketches.

J. McKeen Cattell
Garrison-on-Hudson, N. Y.

QUOTATIONS

WHEN AN INVENTION IS NOT AN INVENTION

There exists in our patent and copyright laws a gap which has always seemed to us a

lamentable one, and one which there is not the slightest justification for leaving unfilled. This has to do with the invention—we use the word though the law denies its propriety—of printed forms for the keeping of accounts or any other purpose.

It goes without saying that much skill and thought may be expended upon the formulation of a set of forms which shall be the last word in furnishing a framework for the proper recording of a certain kind of data. Business of many kinds is dependent upon tabular devices of this sort under one head or another; the invention of such a form may be of great value to its users. It would seem that the man who devotes his time and energy and ingenuity to getting up a thing of the sort ought to be rewarded to the same degree and in the same manner as the man who invents a new safety pin or a novel design for a perfumery bottle or a clever trade-mark. But under the law and the decisions as they now stand he is able to get no protection of any description; you or I or anybody else may manufacture and sell his form in direct competition with him and he has no redress save to undersell us.

The hitch lies in the fact that the law defining invention is so worded that a blank form to be filled in by the user is not an invention. It has no mechanical features, and it is not a process or a product. If the inventor be sufficiently ingenious to design it in such fashion that the user has to punch a hole as part of the process of using it, or join two parts of it in a certain predetermined relationship, or fold the left fifth over upon the right fifth and tear them half off and turn one of them over again in order to bring into juxtaposition two parts of the paper that were originally remote, this constitutes the mechanical feature necessary to make the form stand up under fire as an "invention" entitled to patent protection. But in the absence of such a feature the patent examiners will have nothing to do with it; and if the unhappy inventor turns to the copyright division, he learns that whether his device is an invention or not, it certainly is no publication and he can not protect it by copyright. Even the feeble solace of a design patent seems denied him.

The situation has long been familiar to us. We are inspired to comment on it by a subscriber who shows us a farmers' account book which he has devised. This is an admirable article, and at the same time it fills a want; for the farmer, never an accountant, is required to keep accounts under penalty of paying an income tax on a lot of income that isn't income. But our subscriber can't advertise his little book decently, for if he does some substitute that doesn't have to meet any advertising expense will appear and wipe out his market. We think he has a grievance against the government that tells him that an invention is sometimes an invention and sometimes isn't.—*Scientific American.*

SCIENTIFIC BOOKS

"The Airplane." By FREDERICK BEDELL, Cornell University. D. Van Nostrand Co. Pp. 257.

The theory of flight has more than kept pace with the development of the airplane. It is possible, on the basis of constants determined in wind tunnels, to predict very closely the performance of an existing airplane or to design a plane for some desired performance. The fundamentals of this theory of flight are embodied in a number of recent treatises and are readily available to the student. In Bedell's work they are not only available but are presented in so attractive and understandable a form as to compel the interest of the reader. The present reviewer has read the book through twice, for the pleasure of following so masterly a presentation. Everything is reduced to its simplest terms; every idea is driven home; the influence of each element is illustrated by a series of graphs; the whole subject seems to develop itself. It is a book for the amateur, but it is also the best of beginning books for the serious student. And it explains so convincingly many things which are troublesome to the beginner, as for example, why can not speed be increased in level flight

merely by opening the throttle, as in the case of an automobile.

Professor Bedell's book shows an unusual gift for clean cut analysis and exposition; there are but few scientific or technical books that demonstrate these qualities in so high a degree.

The book does not attempt to extend the science of aeronautics. It is devoted primarily to a discussion of the problem of sustentation; the matter of stability is also treated, but in a qualitative way. It falls in a category between the popular book, superficial and inadequate, and the treatise, involved, and complicated. It is a book destined for a long and useful life.

Lionel S. Marks

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SPECIAL ARTICLES

A FURTHER NOTE ON WAR AND POPULATION[1]

In a note published last summer[2] I drew attention to the course of the ratio

$$\frac{100 \text{ Deaths}}{\text{Births}}$$

in the principal belligerent countries of Europe between 1913 and 1918. All of the curves presented, with the single exception of that for Prussia, ended on a high point in 1918. The question was raised as to what would be their course after that year, and it was shown that England and Wales gave a value of 73 per cent. for 1919 against 92 per cent. for the high point in 1918. The first three quarters of the year 1920 give for England and Wales a value of 46.8 per cent. This is 10 points *lower* than the figure for 1913! For every death England had more than two births.

The *Journal Officiel* has recently published the 1919 figures for France (77 non-invaded departments only) to the following effect:

$$\frac{100\ D}{B} = \frac{63569400}{413379} = 154 \text{ per cent.}$$

This figure compares (for the same territory) with 198 in 1918, 179 in 1917, 193 in 1916, 169 in 1915, 110 in 1914, and 97 in 1913. In other words, in the next year immediately following the cessation of hostilities France's death-birth ratio came back to less than that of 1915, the first whole year of the war. With an increase of 157 per cent. in marriages in 1919 over 1918 there seems little risk in predicting that 1920 will show a ratio not far from 100, which will be about the normal prewar status, France having had for some time a nearly stationary population. The 1920 vital index for France may well prove to be considerably below 100.

Another, and even more striking illustration of the exceedingly transitory effect of war upon the rate of population growth, is seen in the figures for the City of Vienna. Probably no large city suffered so severely from the war as did this capital. Yet observe what has happened, as set forth in Table I. To this table I have added, for the sake of rounding out the data of this and the former paper, the death-birth ratios of the United States Registration Area for as many years as they are available, and for England and Wales, 1912 to 1920 (first three quarters of latter year).

TABLE I

Percentage of Deaths to Births

Year	City of Vienna	U. S. Birth Registration Area	England and Wales
1912	80	—	56
1913	85	—	57
1914	86	—	59
1915	113	56	69
1916	143	59	65
1917	195	57	75
1918	229	73	92
1919	162	58	73
1920	—	—	47[3]

These figures are shown graphically in Figure 1.

We note that:

1. The high point of the Vienna curve in 1918, 229 per cent., is higher than that for France (198 per cent.), and probably higher than for any other equally large aggregate of population in the world.

[1] Papers from the Department of Biometry and Vital Statistics, school of hygiene and public health, Johns Hopkins University, No. 27.

[2] Pearl, R., Science, N. S., Vol. LI., pp. 553–596, 1920.

[3] First three quarters of year only.

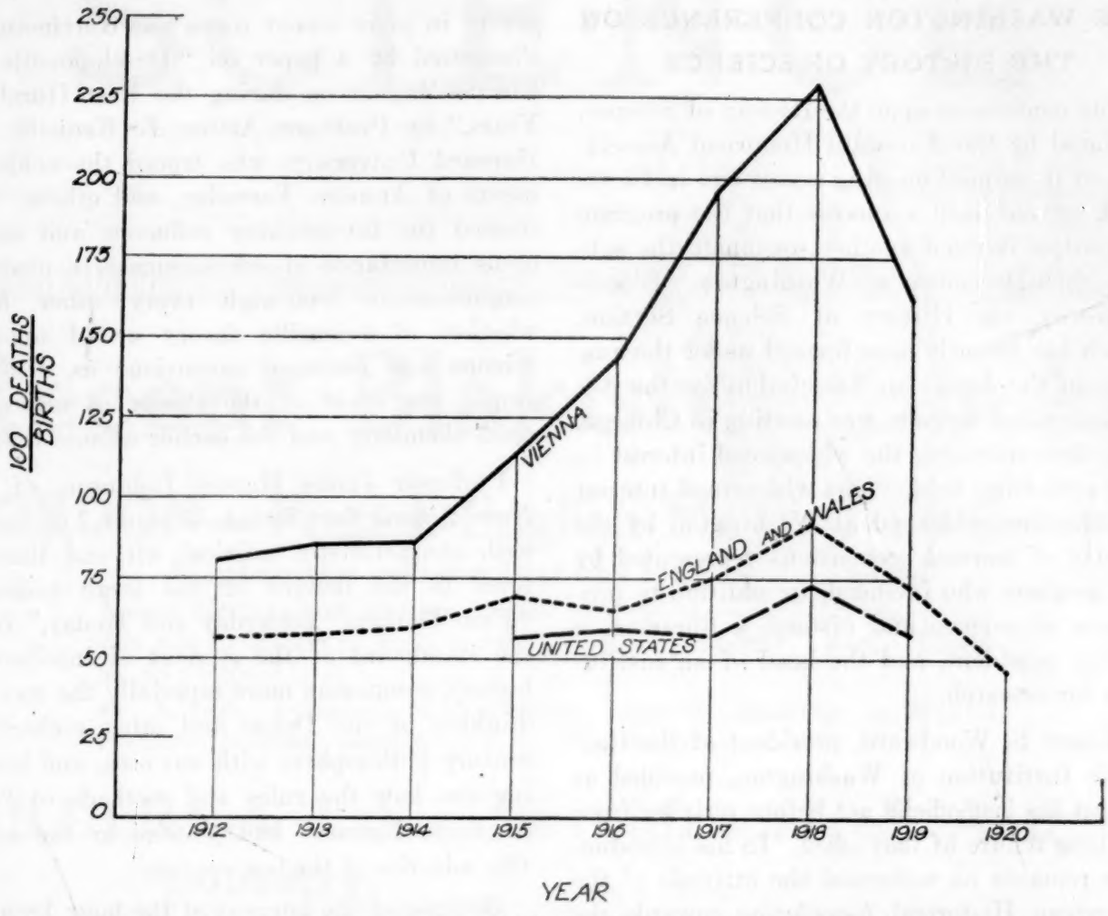

FIG. 1. Showing the change in percentage which deaths were of births in each of the years 1912 to 1919 for Vienna (———); 1915 to 1919 for the United States (— —); and 1912 to 1920 for England and Wales (·····).

2. The drop in 1919 is sharp in its angle and marked in its amount, the percentage coming down nearly to the 1916 figure—and this in spite of the very distressing conditions which prevailed in Vienna throughout 1919. It is not at all improbable, indeed rather it is probable that Vienna will in 1920 show a ratio under 100—that is, more births than deaths. If this happens she will have begun absolute natural increase again in only the second year after the cessation of hostilities, during the last year of which she had 2¼ persons die for every one born.

3. The war produced no effect upon the death-birth ratio in this country, as would have been expected. The influenza epidemic in 1918 raised the curve a little, but it promptly dropped back to normal in 1919.

4. In England and Wales the provisional figure indicates that 1920 will show a lower vital index than that country has had for many years.

Altogether, these examples, which include the effects of the most destructive war known to modern man, and the most devastating epidemic since the Middle Ages, furnish a substantial demonstration of the fact that population growth is a highly self-regulated biological phenomenon. Those persons who see in war and pestilence any absolute solution of the world problem of population, as postulated by Malthus, are optimists indeed. As a matter of fact, all history definitely tells us, and recent history fairly shouts in its emphasis, that such events make the merest ephemeral flicker in the steady onward march of population growth.

RAYMOND PEARL

THE WASHINGTON CONFERENCE ON THE HISTORY OF SCIENCE

The conference upon the History of Science, initiated by the American Historical Association at its annual meeting a year ago in Cleveland, proved such a success that the program committee devoted another session to the subject this December at Washington. Simultaneously the History of Science Section, which has recently been formed under the auspices of the American Association for the Advancement of Science, was meeting in Chicago, thus demonstrating the widespread interest in this promising field. This widespread interest was further evidenced at Washington by the variety of learned occupations represented by the speakers who included, in addition to professors of science and history, a librarian, a college president, and the head of an institution for research.

Robert S. Woodward, president of the Carnegie Institution of Washington, presided as almost his last official act before retiring from his long tenure of that office. In his introductory remarks he welcomed the attitude of the American Historical Association towards the history of science, emphasized the need of breaking down the artificial barriers which divide learning into different departments, and recalled a scheme dating back to 1907 but never executed for a general history of the inductive sciences by a number of collaborators under the direction of the Carnegie Institution.

In a paper on "Recent Realignments in the History of Medieval Medicine and Science," Dr. Fielding H Garrison, librarian, Surgeon General's Office, warned against past exaggeration of medieval ecclesiastical hostility towards science, and against deriding the science of that period. In British libraries alone Mrs. Singer has found 30,000 scientific manuscripts from the medieval period, of which some 15,000 are medical. Dr. Garrison went on to compare the general character of medieval science and medicine with that of other periods including our own, and to appraise its relations to them. The rapid progress of scientific discovery in more recent times was convincingly illustrated by a paper on "Developments in Electro-Magnetism during the Past Hundred Years," by Professor Arthur E. Kennelly, of Harvard University, who traced the achievements of Ampère, Farraday, and others, and showed the far-reaching influence and enormous importance of developments in electromagnetics in well-nigh every other field whether of scientific theory or of applied science and practical invention: as, for example, the effect of the theory of electrons upon chemistry and the earlier atomic theory.

Professor James Harvey Robinson, of the New School for Social Research, discussed with characteristic satirical wit and literary force to the delight of the large audience "Free Thought, Yesterday and To-day," from the standpoint of the student of intellectual history, comparing more especially the ways of thinking of the Deists and other eighteenth century philosophers with our own, and bringing out how the rules and methods of "the intellectual game" had profited by the scientific advance of the last century.

Because of the lateness of the hour Lyon G. Tyler, president emeritus of the College of William and Mary, did not read his paper upon "Science in Virginia." It is to be hoped that not only it but also the other papers which were read may be speedily published and rendered available for a larger audience.

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